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(71) Applicant(s)
Nokia Mobile Phones Limited
(Incorporated in Finland)
Keilalahdentie 4, 02150 Espoo, Finland

(72) Inventor(s)
Marek Szlenski

(74) Agent and/or Address for Service
Venner Shipley & Co
20 Little Britain, LONDON, EC1A 7DH,
United Kingdom

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(54) Abstract Title
Portable battery driven telephone which compares estimated battery operation time with transfer time and allows data transfer if the latter exceeds the former

(57) In a mobile telecommunications system, data is downloaded to a mobile telecommunications handset (MS1) through a PLMN from a WAP server (1) or handset (MS2). Before the download takes place, a check is carried out on the battery of the handset (MS1) to ensure that it has sufficient capacity to support the download. The size of the data file to be downloaded is determined and an estimated time T is computed for the time taken to download the data, which is compared with an estimate t_c of the time that the battery can support the data download. If the battery can support the download, it is initiated but otherwise an error message is displayed.

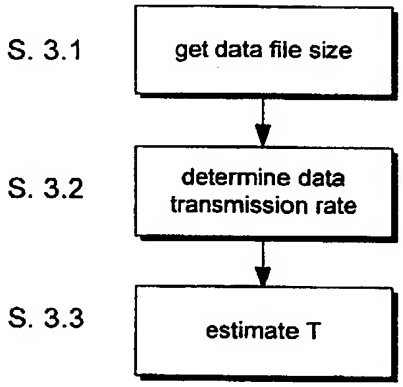

Fig. 6

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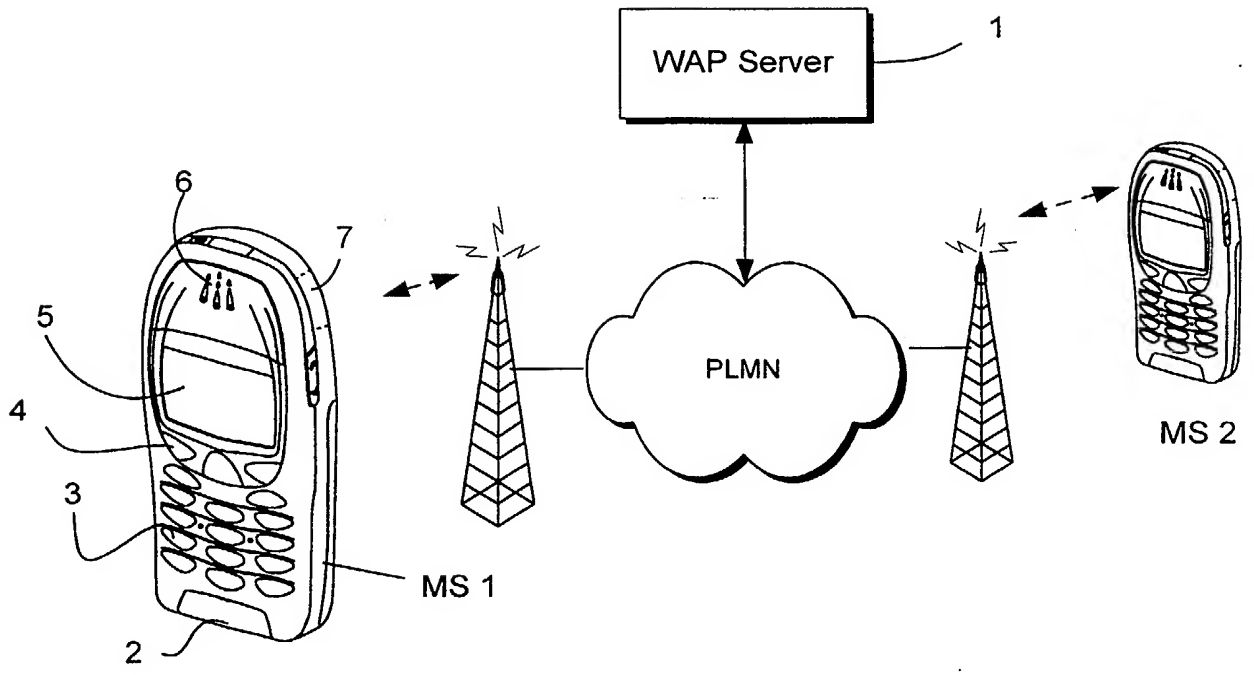
WAP Server
1
6
7
5
4
3
2
MS 1
PLMN
MS 2

Fig. 1

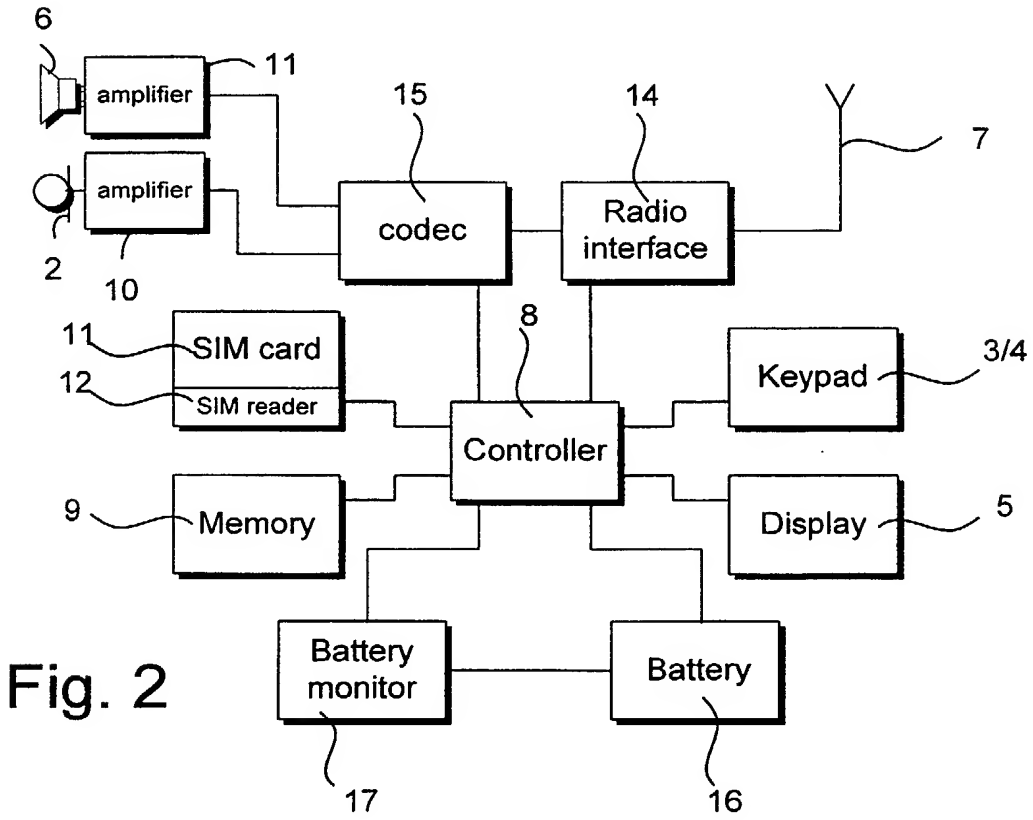
6
amplifier
11
15
14
7
amplifier
2
10
codec
Radio interface
11
SIM card
8
3/4
12
SIM reader
Keypad
Controller
9
Memory
Display
5
Battery monitor
Battery
17
16

Fig. 2

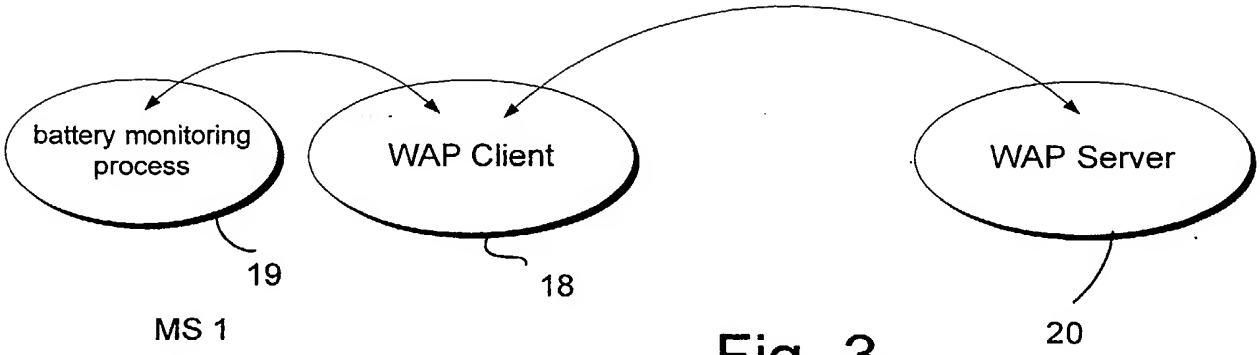
battery monitoring process
WAP Client
WAP Server
19
18
20
MS 1

Fig. 3

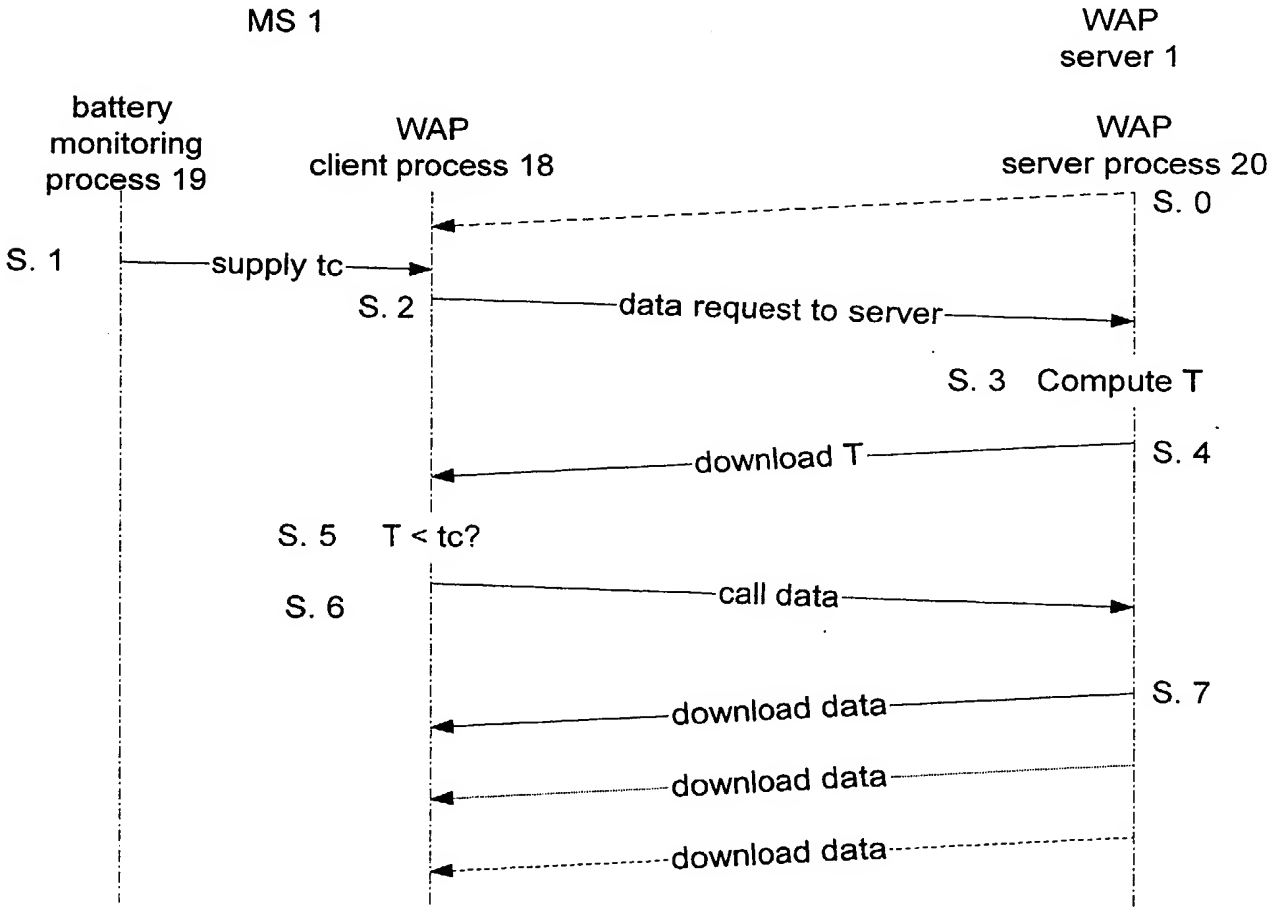
MS 1
WAP server 1
battery monitoring process 19
WAP client process 18
WAP server process 20
S. 0
S. 1
supply tc
S. 2
data request to server
S. 3 Compute T
download T
S. 4
S. 5 T < tc?
S. 6
call data
download data
S. 7
download data
download data

Fig. 4

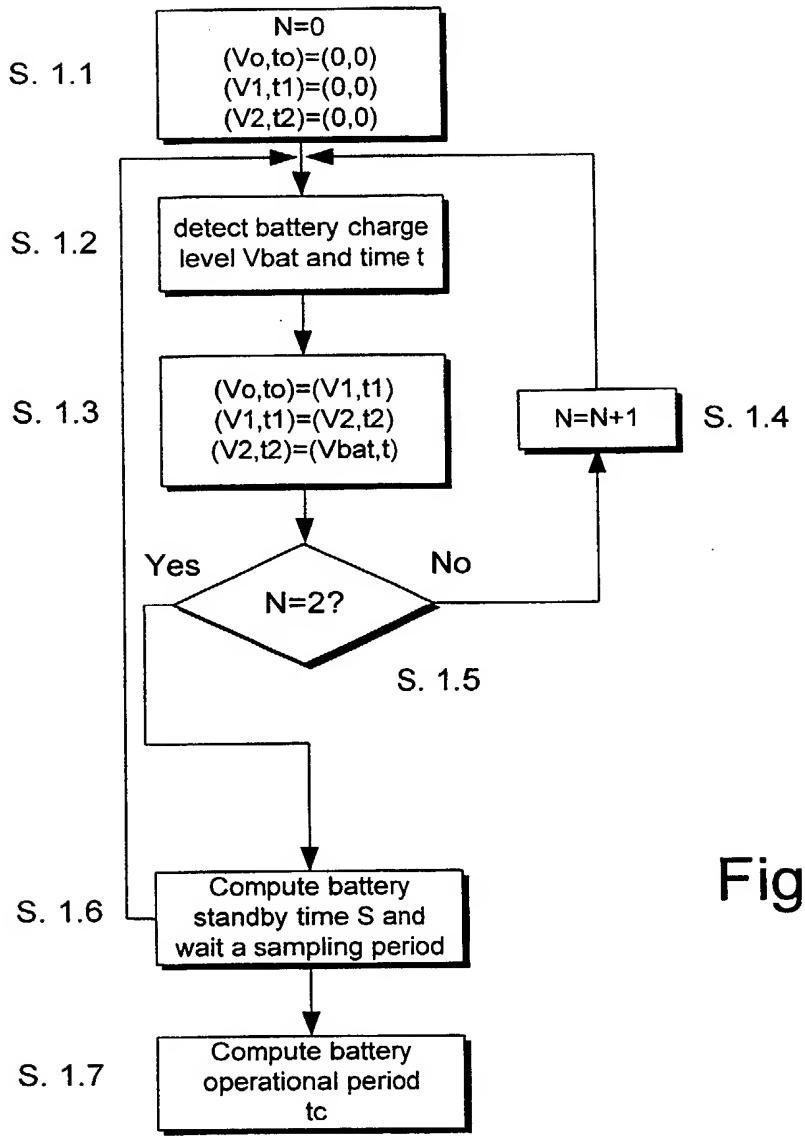
S. 1.1
N=0
(Vo,to)=(0,0)
(V1,t1)=(0,0)
(V2,t2)=(0,0)
S. 1.2
detect battery charge level Vbat and time t
S. 1.3
(Vo,to)=(V1,t1)
(V1,t1)=(V2,t2)
(V2,t2)=(Vbat,t)
N=N+1
S. 1.4
Yes
No
N=2?
S. 1.5
S. 1.6
Compute battery standby time S and wait a sampling period
S. 1.7
Compute battery operational period tc

Fig. 5

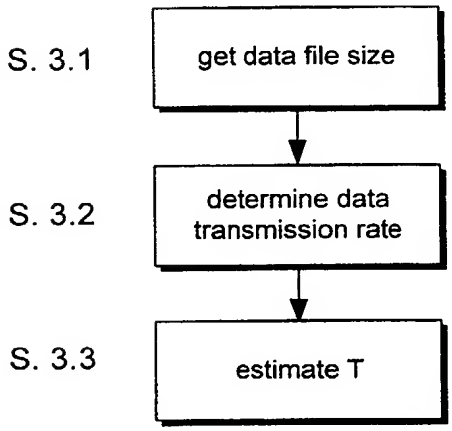
S. 3.1
get data file size
S. 3.2
determine data transmission rate
S. 3.3
estimate T

Fig. 6

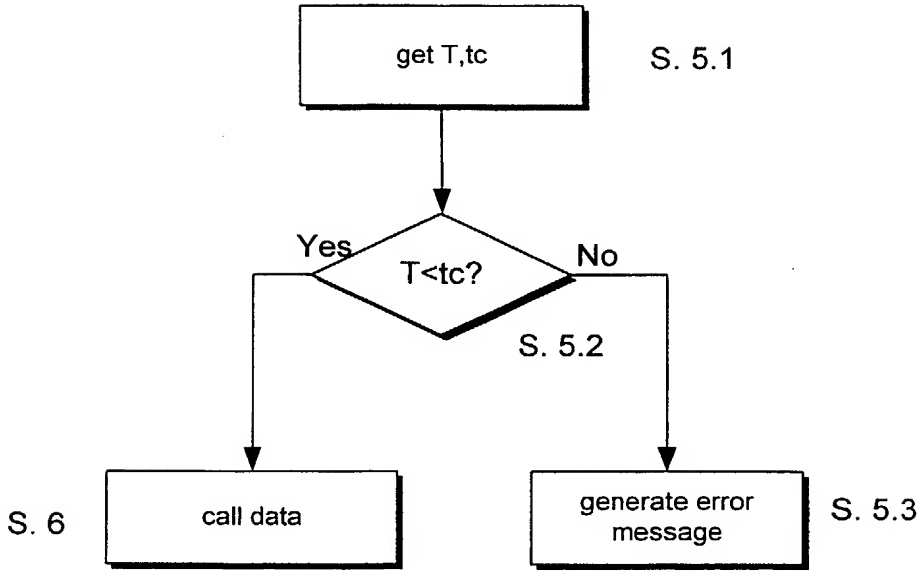
get T,tc
S. 5.1
Yes
T<tc?
No
S. 5.2
S. 6
call data
generate error message
S. 5.3

Fig. 7

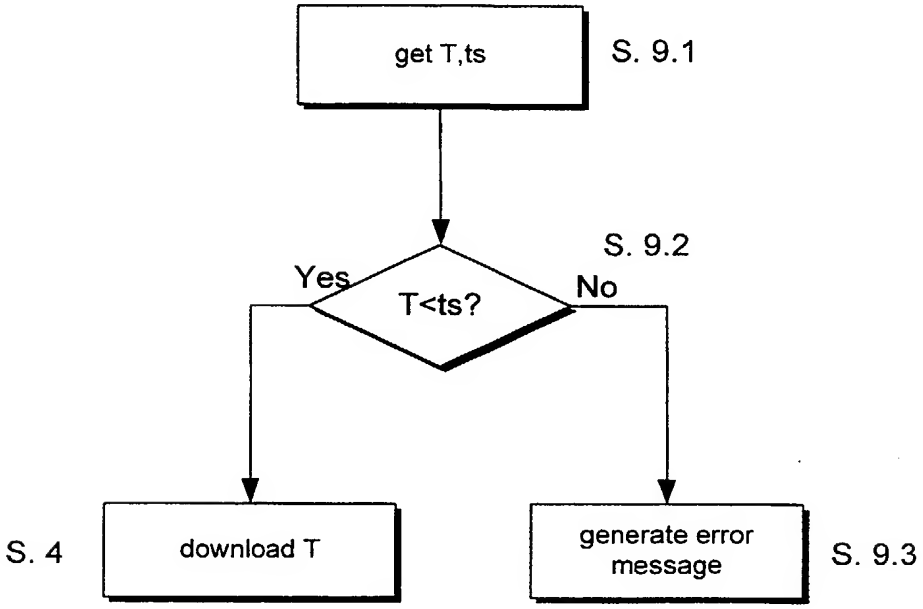
get T,ts
S. 9.1
S. 9.2
Yes
T<ts?
No
S. 4
download T
generate error message
S. 9.3

Fig. 10

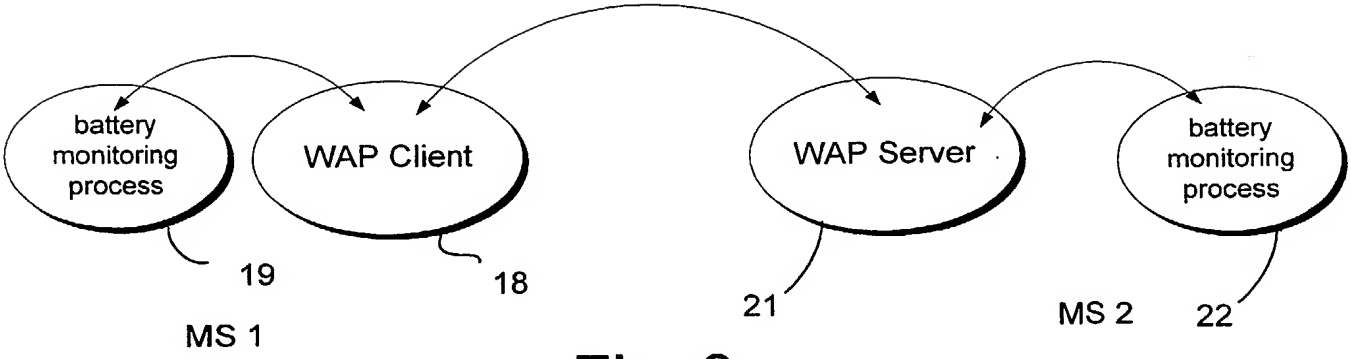
battery monitoring process
WAP Client
WAP Server
battery monitoring process
19
18
21
22
MS 1
MS 2

Fig. 8

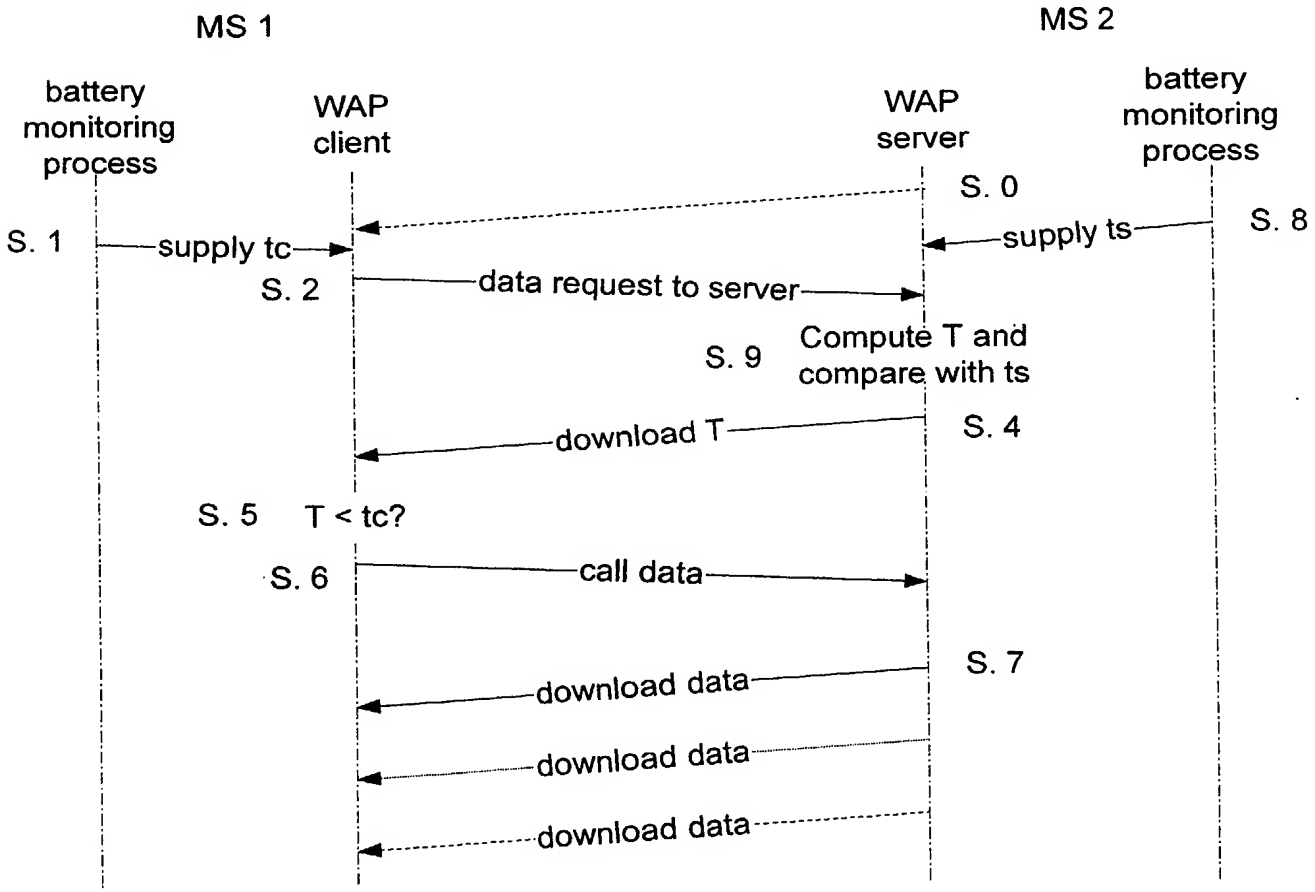
MS 1
MS 2
battery monitoring process
WAP client
WAP server
battery monitoring process
S. 0
S. 1
supply tc
supply ts
S. 8
S. 2
data request to server
S. 9
Compute T and compare with ts
download T
S. 4
S. 5
T < tc?
S. 6
call data
S. 7
download data
download data
download data

Fig. 9

Mobile Data Transmission

Description

This invention relates to portable battery driven apparatus for transferring data through a telecommunications network, for example a battery driven mobile station such as a telephone handset configured to send or receive data through the network.

Conventional mobile stations such as telephone handsets, have been used primarily for speech transmissions although some networks provide a short message service (SMS) allowing text messages to be transmitted and displayed. For example, in GSM, service is provided at a data rate of 9.6 kbit/sec. A wireless application protocol (WAP) has recently been developed in order to allow mobile telephone handsets to be used as web browsers. The mobile station, in use, routes a call to a predetermined telephone number associated with a public land mobile network (PLMN), known as a WAP gateway, which provides connection to a WAP server. The server provides data in wireless markup language (WML) which can be considered as a variant of conventional hypertext markup language (HTML). WML allows data such as text to be arranged in decks of cards, such that when the data is downloaded to a WAP enabled mobile station, individual cards can be displayed one at a time and the user can navigate among the cards without requesting a new document from the server.

Thus, WAP enabled phones are capable of receiving much larger amounts of information and involve a significantly greater amount of messaging activity than conventional SMS. Furthermore, WML files can be interchanged between mobile stations through the PLMN.

Furthermore, it is known that a mobile telephone handset can provide a mobile connection to a laptop computer to enable data files to be downloaded to the computer, for example from the Internet. The laptop computer is provided with a modem and an infra-red link provides a connection between the modem and the mobile telephone handset, so that data exchange with the Internet can occur through the mobile telephone network through a speech channel, using the modem.

Since conventional mobile stations are battery driven, there is a risk that a partially discharged battery will not support operation of the station for a sufficient length of time to enable either downloading or uploading of a relatively large amount of information.

The present invention seeks to provide a solution to this problem. According to the invention there is provided a portable battery driven apparatus for use in transferring data through a telecommunications network, including a processor configuration to receive transfer time information corresponding to a estimate of the time to be taken to transfer the data, compute an estimate of a battery operation time corresponding to the time for which the battery can support the data transfer, compare the estimated battery operation time and the transfer time, and to signal initiation of the data transfer if estimated battery operation time exceeds the data transfer time.

The apparatus may be operable as a client to receive the data from a remote server, and configured to receive the transfer time information from the remote server, and to request the server to download the data if the estimated battery operation time exceeds the data transfer time.

The apparatus may be operable as a server to download the data to a remote client and configured to provide the data transfer time information in respect of the data to be downloaded. The data transfer time information may be compared with the estimated battery operation time for the server to determine if the server can download the data.

The apparatus may include a battery monitor operable to derive successive samples of the battery voltage and determine its discharge characteristics from the samples. The samples may be taken during a first mode of operation e.g. idle mode to determine a time that it can support operation in the first mode i.e. the standby time, and to compute from the standby time the battery operation time for a second mode e.g. dedicated mode during which the data transfer will take place.

The apparatus may comprise a mobile station for a mobile telephone network, such as a telephone handset and may be WAP enabled although other data formats can be used. The apparatus may also comprise a personal data assistant (PDA).

The invention may also be used in connection with other battery driven apparatus, such as a laptop computer connected by means of a modem to a telecommunications network.

The invention also includes a method of transferring data through a network between a server and a client, at least one of which is driven by a battery, comprising estimating a transfer time corresponding to the time to be taken to transfer the data between the client and server, estimating a battery operation time corresponding to the time for which the battery can support the data transfer, comparing the estimated battery operation time and the transfer time, and initiating the data transfer if estimated battery operation time exceeds the data transfer time.

In another aspect the invention includes a method of operating a battery driven client to receive data transferred thereto through a network from a server, comprising receiving an estimate of a transfer time corresponding to the time to be taken to transfer the data between the client and server, estimating a battery operation time corresponding to the time for which the battery can support the data transfer, comparing the estimated battery operation time and the transfer time, and initiating the data transfer if estimated battery operation time exceeds the data transfer time.

The invention further includes a method of operating a battery driven server to transfer data through a network to a client, comprising estimating a transfer time corresponding to the time to be taken to transfer the data between the client and server, estimating a battery operation time corresponding to the time for which the battery can support the data transfer, comparing the estimated battery operation time and the transfer time, and enabling the data transfer if estimated battery operation time exceeds the data transfer time.

In order that the invention may be more fully understood an embodiment will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic block diagram illustrating mobile telephone handsets which communicate through a PLMN to each other and a WAP server;

Figure 2 is a schematic block diagram of the circuitry of mobile handset MS1 shown in Figure 1;

Figure 3 is a schematic illustration of the processes that occur in the handset MS1 and the WAP server;

Figure 4 illustrates the data transfer process that occurs when the mobile handset MS1 requests data to be downloaded from the WAP server;

Figure 5 is a schematic block diagram of the battery monitoring process;

Figure 6 illustrates a process for sizing the data to be transmitted;

Figure 7 illustrates a process to determine whether the download time T for the data is less than the time that the battery of mobile station 1 can sustain operation during the download;

Figure 8 illustrates a downloading process for which data is transferred between handsets MS1 and MS2;

Figure 9 illustrates the data transfer process when data is transferred between handsets MS1, MS2; and

Figure 10 illustrates a process to determine whether the estimated data transfer time T exceeds the battery capacity for the server handset MS2.

In Figure 1, first and second mobile stations in the form of battery driven telephone handsets MS1, MS2 are shown schematically in radio communication with a PLMN, which in turn is coupled to a WAP server 1 through a WAP gateway (not shown).

Considering the mobile handset MS1, it includes a microphone 2, keypad 3, soft keys 4, a liquid crystal display 5, earpiece 6 and an internal antenna 7. As will be explained in more detail, both of the handsets MS1, MS2 are WAP enabled.

The circuitry of the handset MS1 is shown in more detail in Figure 2 and it will be understood that handset MS2 is of the same general configuration. Signal processing is carried out under the control of a digital micro-controller 8 which has an associated flash memory 9. Electrical analogue audio signals are produced by microphone 2 and amplified by preamplifier 10. Similarly, analogue audio signals are fed to the earpiece 6 through an amplifier 11. The micro-controller 8 receives instruction signals from the keypad and soft keys 3, 4 and controls operation of the LCD display 5.

Information concerning the identity of the user is held on a smart card 12 in the form of a GSM SIM card which contains the usual GSM international mobile subscriber identity and encryption key K_i that is used for encoding the radio transmission in a manner well known *per se*. The SIM card 12 is removably received in a SIM cardholder 13. Radio signals are transmitted and received by means of the antenna 7 connected through a rf stage 14 to a codec 15 configured to process signals under the control of micro-controller 8. Thus, in use, for speech, the codec 15 receives analogue signals from the microphone amplifier 10 digitises them into a form suitable for transmission and feeds them to the rf stage 14 for transmission through antenna element 7 to the PLMN shown in Figure 1. Similarly, signals received from the PLMN are fed through the antenna element 7 to be demodulated by the rf stage 14 and fed to the codec 15 so as to produce analogue signals fed to amplifier 11 and earpiece 6.

The handset is WAP enabled and capable of receiving data in a predetermined channel, e.g. for GSM, at 9.6 kbit/sec. Also, the handset may be configured to receive high speed circuit switch data (HSCSD) according to the GSM recommendations. The data rate is 14.4kbit/s if one time slot per frame used, 28.8kbit/s if two time slots are used with the possibility of being increased up to 115kbit/s if all eight time slots are used. It will however be understood that the invention is not restricted to any particular data rate and higher data rates could be used. The controller 8 provides a WAP browser functionality in order to display WML cards on the display 5. Cards of a particular WAP deck can be manipulated

using the keys 3, 4. Downloaded WML files can be stored in the memory 9, and also data can be uploaded from memory 16 as will be explained in more detail later.

The handset MS1 is driven by a conventional rechargeable battery 16 and the battery voltage V_{bat} is monitored by a battery monitor circuit 17.

The battery 16 is thus initially charged and gradually discharges with use. The voltage across the battery terminals V_{bat} thus is initially at the relatively high level and reduces in value as the battery becomes progressively more discharged. As well known in the art, the handset MS1 is operable in different modes. In the first, idle mode, the handset MS1 remains in periodic contact with the PLMN in order to be ready to receive and transmit calls and to perform location updates periodically. In a second, dedicated mode, speech or data transmission occurs between the handset and the PLMN e.g. when data is downloaded to the handset or a speech call is performed. During idle mode, the power consumption is relatively low but a much higher power consumption occurs during the dedicated mode, when data or speech is transmitted. Thus, in idle mode, the battery exhibits a relatively long standby time whereas in dedicated mode, power is consumed more quickly and as a result the battery can only support operation of the handset for a much shorter time than the standby time for idle mode operation.

It is known from US-A-5 844 884 that the battery voltage course during discharge can be estimated during the actual discharge of the battery. The estimate is made by successively taking samples of the battery voltage at known times. As disclosed in detail in the US Patent, by taking three measurements at known times, it is possible to predict the remaining time during which the battery can support standby operation of the handset i.e. in idle mode. The battery discharge is a generally exponential time dependent function and by taking successive battery samples, it is possible to approximate the various constants which characterise the decay and thereby predict the time for which the battery can continue to support operation of the handset. Furthermore, the US Specification discloses that the estimated time for standby, i.e. idle mode, is related to the time for which the battery can support dedicated mode operation. Thus, having computed the estimated standby time, it is

possible to multiply the estimate by a predetermined function in order to estimate the time for which the battery can support dedicated mode operation. Reference is directed to the aforesaid US Patent for further information. The battery monitor 17 shown in Figure 2 operates according to the principles of US-A-5 844 884.

When a user of the handset MS1 requests data to be downloaded from WAP server 1 shown in Figure 1, the download time may be relatively long, due to the restricted bandwidth for downloading the data through the PLMN. There is a risk that the battery 16 may be sufficiently discharged that it cannot support operation of the handset for sufficient time to enable the download to occur. An example will now be described in which this problem is overcome. Figure 3 illustrates the processes that occur when data is downloaded from WAP server 1 to the handset MS1. The handset circuitry shown in Figure 2 operates to perform WAP client processes 18 and a battery monitoring process 19. The WAP client process 18 interchanges data with a WAP server process 20 provided by the WAP server 1 shown in Figure 1.

The communication of information between the WAP server, client and battery monitoring processes will now be described with reference to Figure 4. At step S1, the battery monitoring process supplies to the WAP client process 18, an estimate of the time t_c for which the battery 16 can support the downloading of data from WAP server 1 to the handset MS1. In fact the value of t_c may be supplied on a continuous, updated basis during operation but is shown as a single step in Figure 4 in order to simplify the description.

At step S2, when the user wishes to download a particular data file from WAP server 1, a data request is sent to the server.

Then, at step S3, the WAP server processes 20 compute an estimate T of the time to be taken to transfer the data file to the handset 1 i.e. the time taken to download the file to the handset. Then, at step S4, the estimated value T is downloaded to the WAP client process 18 through the PLMN.

At step S5, the WAP client process 18 compares the values of T and t_c in order to determine whether the battery can support operation of the handset 1 for a sufficient time to allow the requested data to be downloaded from the server to the client.

If the estimated download time T is less than t_c, the battery 16 can support the requested downloading of data and so at step S6, a data call signal is transmitted to the server 1. As a result, the process 20 commences downloading of the data, as shown at step S7. It will be understood that the downloading of the data may take a significant period of time but, in accordance with the invention, it has been determined at step S5 that the battery can support the time required to download the data. Without this check, there is a risk that the downloading would commence, but that the battery would fail before completion, with the result that the handset would be tied up for a significant period of time and no useful result would have been achieved because only part of the data had been downloaded before the battery failed to support the downloading operation.

A more detailed description of some of the individual steps in Figure 4 will now be described with references to Figures 5, 6 and 7.

Figure 5 illustrates the battery monitoring process 19 (step S1) in more detail. As previously explained, three measurements of the battery voltage V_{bat} are taken at equally spaced times, and used to compute a standby time S for the battery, when the handset MS1 is in idle mode. The process continues over successive equally spaced sample periods and as a result, the estimated standby time S is continuously updated. The process starts at step S1.1 at which the values for three voltage samples V0, V1 and V2, taken at times t0, t1 and t2 are all set to zero. Also, an integer counter parameter N is set to zero.

At step S1.2, a sample of the battery voltage V_{bat} is taken time t. At step S1.3, the parameters V0, V1 and V2 are incremented and the process is repeated to build up three successive battery voltage samples, using the parameter N, which is incremented at step S1.4. When three successive values have been established, they

are used in a computation process described more fully in relation to equations (8) (9) and (10) disclosed in US-A-5 844 884 to compute a standby time S for the battery during idle mode. The process then repeats to derive second successive samples of the standby S during the course of discharge of the battery.

Then, at step S1.7, the estimate of the operational time of the battery for its dedicated mode for data transfer is computed in order to obtain an appropriate value of t_c. This can be carried out as described in US-A-5 844 884 in relation to equation (15).

As previously explained, the WAP server process 20 computes at step S3 (Figure 4) an estimate of the time T to be taken to download the requested data, when a request is received from the WAP client process 18. The process to compute T is shown in more detail in Figure 6. At step S3.1, the WAP server process 20 gets the data requested at step S2 and determines its file size.

At step S3.2, the data rate for downloading the requested data to the handset MS1 through PLMN is determined. This may for example be a predetermined rate such as the 9.6 kbit/sec rate previously mentioned or may be a selectable rate in some circumstances. At step S3.3, the data obtained at step S3.1 and S3.2 is used to obtain the estimate of the time T to be taken to download the data file concerned.

Figure 7 illustrates the process carried out at step S5 in Figure 4, when the estimate T has been downloaded to WAP client process 18. The estimated download time T for the data is compared with the time t_c that the battery can support downloading of the data. Thus, when the data T, t_c is obtained at step S4.1, the data are compared at step S4.2 if the battery can support the download, the data is called from the server at step S5. Otherwise, an error message is generated at step S4.3, which may be displayed on the display 5 in order to indicate to the user that the requested downloading of data cannot proceed because of the condition of the battery 16.

Another data downloading process will now be described in which data is downloaded from handset MS1 to handset MS2 through the PLMN. The processes carried out at the handset MS1, MS2 are shown in more detail in Figure 8. As before, the handset MS1 acts as a client, with the client process 19 and battery monitoring process 18. Similarly, in this example, the handset MS2 acts as the server and performs a WAP server process 21. The battery of the handset MS2 is monitored by a battery monitoring process 22 using its battery monitor circuit 17.

The information interchange between the handsets is shown schematically in Figure 9 which is generally similar to Figure 4 although extra steps are taken to ensure that the battery of MS2 is monitored to ensure successful downloading of the data.

Thus, at step S1, the value of t_c is supplied to the WAP client process from battery monitoring process 18 and, at step S2, the data request is transmitted to the WAP server process 21 from handset MS1.

Similarly, at step S8, the status of the battery of handset MS2 is monitored and an estimate t_s of the battery operation time for which the battery can support downloading of data is supplied to the WAP server process 21.

At step S9, the value of t_s is compared with the computed value of T and, if the battery of the handset MS2 can support the download, the value of T is downloaded to handset MS1 at step S4. Then as previously described, the value of T is compared with the estimated time t_c that the battery of handset MS2 can support data transfer, and if the outcome is satisfactory, data is called at step S6. Then, at step S7, the data is downloaded as previously described.

The step S9 is shown in more detail in Figure 10. The data T and t_s is obtained at step S9.1 and compared at step S9.2. If the battery operation time t_s is greater than the estimated download time T, the value of T is downloaded to the WAP client process 19 at handset MS1. However, if the battery of MS1 cannot support the download, an error message is generated at step S9.3. The error message may be

displayed on the screen 5 of the handset MS2 and may additionally be downloaded to handset MS1 for display on the screen 5 thereof.

Thus the procedure ensures that batteries of both handsets MS1, MS2 are in a suitable condition to enable the downloading of the data.

Many modifications and variations are possible. For example, whilst in the data interchange shown in Figure 9, the downloading of data is requested by the user of MS1, the download may alternatively be commanded by the user of handset MS2. This can be achieved by an additional step S0 in which the user of handset MS2 causes a download command to be transmitted to the handset MS1 and the client process 19 is configured to respond to the command by causing the data request at step S2 to be sent back to the server and initiate the downloading process. A similar command S0 can be used in the process described with reference to Figures 3 and 4. This can be used with advantage to download large data files to the client. For example, it may be desired to download a MP3 music or video file to a telephone handset. With presently available algorithms, three minutes of music can be compressed into a 2MB file. MP3 players for connection to mobile telephone handsets have been announced, for example the HPM-10 by Ericsson, which connects to, for example their T28 handset, and it would be desirable to download MP3 files to the player through a mobile telephone network. The invention enables the downloading to be carried out under conditions in which the battery capacity of the telephone handset will support the downloading process in its entirety. It may then be desired to transfer the MP3 file from one handset to another, and the invention may ensure that the batteries of both the handsets involved will support the file transfer through the mobile network.

Also in another modification, the step S9, performed in the WAP server process 21, can be carried out in the WAP client process 19, by downloading both T and t_s at step S4. Then a combined comparison of T with t_c and t_s can be carried out at step S5. Similarly, if desired, t_c can be uploaded to WAP server process 21 so that the comparison carried out at step S5 is instead carried out in the WAP server process 21.

Whilst the invention has been described by example with reference to a mobile telecommunications system it has application to other battery driven apparatus, for example PDAs and laptop computers. The process can for example be used with a laptop computer to ensure that when large data files are downloaded to the laptop, its battery capacity is sufficient to enable the downloading to occur without failure. The invention can be used with data protocols other than WAP such as HTML and TCPIP.

Claims

1. Portable battery driven apparatus for use in transferring data through a telecommunications network, including a processor configuration to receive transfer time information corresponding to a estimate of the time to be taken to transfer the data, compute an estimate of a battery operation time corresponding to the time for which the battery can support the data transfer, compare the estimated battery operation time and the transfer time, and to signal initiation of the data transfer if estimated battery operation time exceeds the data transfer time.

2. Apparatus according to claim 1 operable as a client to receive the data from a remote server, and configured to receive the transfer time information from the remote server, and to request the server to download the data if the estimated battery operation time exceeds the data transfer time.

3. Apparatus according to claim 1 or 2 operable as a server to download the data to a remote client, and configured to provide the transfer time information for the data to be downloaded

4. Apparatus according to claim 3 and operable to compare the transfer time information with the estimated battery operation time for the server to determine if server can download the data.

5. Apparatus according to claim 3 or 4 and operable to download data corresponding to the transfer time to the client.

6. Apparatus according to any preceding claim including a battery monitor operable to derive successive samples of the battery voltage and determine its discharge characteristics from the samples.

7. Apparatus according to claim 6 wherein the battery monitor is operable to derive the successive samples of battery voltage during a first mode of operation of the apparatus so to determine a time that it can support operation in the first mode,

and to compute the battery operation time in respect of a second mode for the data transfer.

8. Apparatus according to claim 7 wherein the first mode is an idle mode and the second mode is a dedicated mode for data transfer.

9. Apparatus according to any preceding claim and comprising a mobile telephone handset.

10. Apparatus according to claim 9 wherein the handset is WAP enabled.

11. Apparatus according to any preceding claim and comprising a PDA.

12. Apparatus according to any preceding claim and comprising a laptop computer.

13. A method of transferring data through a network between a server and a client, at least one of which is driven by a battery, comprising estimating a transfer time corresponding to the time to be taken to transfer the data between the client and server, estimating a battery operation time corresponding to the time for which the battery can support the data transfer, comparing the estimated battery operation time and the transfer time, and initiating the data transfer if estimated battery operation time exceeds the data transfer time.

14. A method according to claim 13 wherein the client comprises portable battery driven apparatus to receive the data through a telecommunications network from the server, and including estimating the transfer time at the server, estimating the battery operation time at the client, downloading data corresponding to the transfer time from the server to the client, comparing the transfer time and the battery operation time at the client, and requesting the server to download the data to be transferred if the transfer time is less than the battery operation time.

15. A method according to claim 13 or 14 wherein the server comprises portable battery driven apparatus to serve the data through a telecommunications network to the client, and including estimating the transfer time at the server, estimating the server battery operation time at the server, comparing the transfer time and the server battery operation time, and requesting the server to download the data to be transferred to the client if the transfer time is less than the server battery operation time.

16. A method of operating a battery driven client to receive data transferred thereto through a network to a from a server, comprising receiving an estimate of a transfer time corresponding to the time to be taken to transfer the data between the client and server, estimating a battery operation time corresponding to the time for which the battery can support the data transfer, comparing the estimated battery operation time and the transfer time, and initiating the data transfer if estimated battery operation time exceeds the data transfer time.

17. A method of operating a battery driven server to transfer data through a network to a client, comprising estimating a transfer time corresponding to the time to be taken to transfer the data between the client and server, estimating a battery operation time corresponding to the time for which the battery can support the data transfer, comparing the estimated battery operation time and the transfer time, and enabling the data transfer if estimated battery operation time exceeds the data transfer time.

18. Portable battery driven apparatus substantially as herein described with reference to the accompanying drawings.

19. A method of operating a client and/or a server substantially as herein described with reference to the accompanying drawings.

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Other: Online: WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2337423A	(NEC)	
A	GB2328844A	(NEC)	
A	GB2328588A	(SAMSUNG)	
A	JP9252360	(TOSHIBA)	

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